# *Compost Operators Training Certificate Course*

# *Overview*

- Characteristics of Materials
- Material Generation Rates
- Collection Options
- Commingling Materials
- Collection Equipment Options
- Food Waste Collection

# *Introduction*

- **Goal: Maximize diversion from landfill**
  - **Leave, grass, brush**
  - **Food waste, wood waste, non-recyclable or soiled paper, biosolids**
- **Considerations**
  - **How much volumes is out there?**
  - **How much can be feasibly composted?**
  - **What are the material characteristics?**
  - **How will I collect and transport this material?**

# *Landfilling Impact*

- **Material set to a landfill will decompose anaerobically**
- **Anaerobic decomposition releases $CH_4$ into the atmosphere**
- **$CH_4$ is 23X worse than $CO_2$ so the Food Waste we generate and compost REALLY MATTERS**

# The Numbers Behind Your Food Waste

Food waste represents **25%** of US methane emissions

1 ton Methane = 12 tons $CO_2$ Equivalent

Sustainable waste management, reduction, and disposal practices are a valuable piece of the supply chain.

## 1/3 of MSW

is food-related waste

**5 lbs**

per day, per person


FOOD WASTE PILES UP THROUGHOUT THE CHAIN, BUT WE THE MOST AT THE CONSUMERS STAGE

Equivalent of $165 Billion Per Year

10% of institutional food purchases become waste

another 4%-10% become waste before ever reaching the customer

In cafeterias, each meal tray generates ½ lb of food waste.*

A closed system is a good place to start a zero waste campaign

Source: Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill; Author Dana Gunders, Natural Resources Defense Council

# Biggest Sources of Food Waste
## (in order)

## Food Service Industry

- Commercial
  - **Restaurants**
    - Quick Service
    - Full Service
  - **Grocery Stores**
- Institutional
  - K-12, Universities, Hospitals, Nursing Homes, Prisons


## Residential

EPA United States Environmental Protection Agency

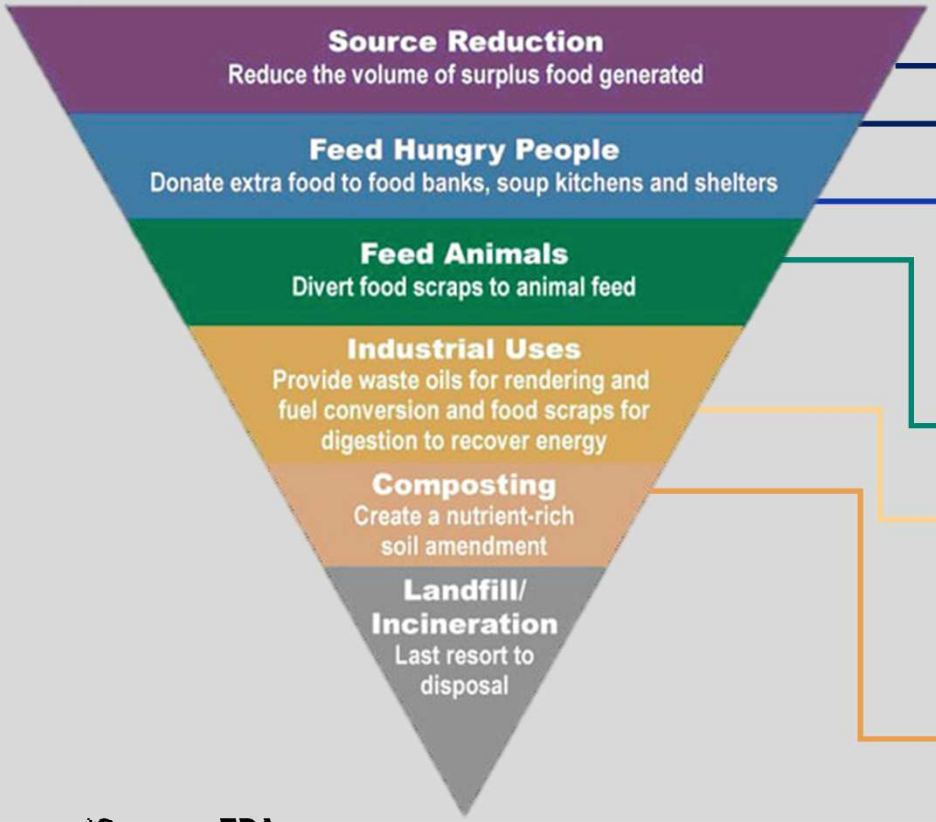
Does not include agricultural and industrial food wastes

# *Other Benefits of Food Waste*

- ✓ **Removes a high water content stream from leachate production in landfills**
- ✓ **Improves compost characteristics of other feedstocks like yard debris**
- ✓ **Positive economic benefits**
- ✓ **Improves soil tilth when finished compost is used as an amendment**
- ✓ **Positive public image**

# Characterization and Collection

## How to Reduce Food Waste?
## What can be done with Leftover Food Waste?




**Reduce purchasing volumes and packaging**

**Educate on food preservation / expiration dates**

**Donate to a food bank**

**Send residuals to a hog farm**

**Industrial Uses – Provide fats for rendering and biofuel and food scraps for digestion**

**Compost**

***Source: EPA**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# *Characterization and Collection*

# Material Characteristics

| | Volume | Characteristics |
|---|---|---|
| Leaves | 160 lbs/ household /yr<br>*0.8 cubic yards, loose* | C:N ratio: 80:1<br>Moisture content: 10-50%<br>Density: 150-700 lbs/cy<br>High carbon & mineral content<br>Composts alone, but slowly, with little odor<br>Stockpile to add to grass in spring/summer |
| Grass | 1,040 lbs/ household /yr<br>*2.6 cubic yards, loose* | C:N ratio: 15:1<br>Percent moisture: 60-80%<br>Density: 400-800 lbs/cy<br>Decomposes quickly<br>Good nitrogen source<br>Strong potential for odor |
| Brush and Tree Trimmings | 300 lbs/household/yr<br>*1 cubic yard, loose* | C:N ratio: 200-500:1<br>Percent moisture: 40-50%<br>Density:250-500 lbs/cy<br>Very slow to break down<br>Collect chipped, bulk or with leaves/grass |
| Food | 255 lbs/household/year<br>1.64 tons/empl/yr (food service)<br>0.71 tons/empl/yr (restaurants)<br>19.29 tons/empl/yr (food processors) | C:N ratio: variable, typical 15:1<br>Percent moisture: variable<br>Density: 800-1000 lbs/cy<br>Good nitrogen source<br>Need to mix with leaves, potential for odor<br>Significantly increases organic diversion rates |

# *Yard waste generation factors*

- Urban, rural, suburban
- Community affluence
- Climate
- Maturity of trees in the area
- Average lot size
- Yard waste reduction incentives

# *Yard Waste Generation Rates (hh/yr)*

| *Material* | *Pounds* | *Cubic Yards Loose* |
|---|---|---|
| **Leaves** | **160** | **0.8** |
| **Grass** | **1,040** | **2.6** |
| **Brush** | **300** | **1.0** |
| **Total** | **1,500** | **4.4** |

# *Organic Waste Generated*

- 4.4 cubic yards of yard clippings per household per year
  - ~1500 pounds annually
  - ~2 to 5 paper bags per week (average)
  - 18%-25% of the residential waste steam
  - 60% generated May - September
- Other organics
  - food and soiled paper
  - 10%-17% of the residential waste steam

# *Collection of Food Waste*

- Next big "gain" for recycling
- Food waste:
  - Nationally, 31.8 M tons generated, and only 2.5% diverted
  - 29% of Michigan's municipal waste stream
  - Compost sites managing only 10% of that
- Yard waste:
  - Nationally, 32.9 M tons generated, 64.7% diverted
- Avoid disposal costs

# *Volumes & Sources Considerations*

- Survey ad Pilot to collect data on participation and volumes
- Evaluate volumes of different compostable materials (FW, YW, woodchips, bioware, paper)
- In-building collection and material preparation considerations (bins, pulper, digester, compactor, dock space)

# Characterization and Collection

## Estimating Volumes and Sources

### ❖Household

| | |
|---|---|
| FW Generation | 350 lbs/hhld/yr |
| Food Waste Density | 600 lbs/CY |
| FW Participation Rate | 45% |
| YW Generation | 500 lbs/hhld/yr |
| YW Density | 350 lbs/CY |
| YW Participation Rate | 75% |

### ❖Commercial

| | |
|---|---|
| Participation Rate | 25% |
| FW Annual Generation (tons) | 150 tons/est/yr |
| FW Density (lbs/cy) | 600 lbs/CY |

### ❖Institutional

| | |
|---|---|
| Hospital lbs | 1.8 lbs/bed/day |
| FW Hospital Participation Rate | 80% |
| Prison lbs | 1 lbs/inmate/day |
| FW Prison Participation Rate | 80% |
| University lbs | 0.35 lbs/student/day |
| FW University Participation Rate | 80% |
| Public Schools lbs | 0.35 lbs/student/day |
| FW Public Schools Participation Rate | 80% |

**Other Food Waste Assessment Tools:**
http://www.epa.gov/foodrecovery/tools/index.htm

**See EXCEL worksheets**

# Characterization and Collection

## Optimizing initial mix

| | Weight (tons/year) | Weight (lbs/year) | Volume (CY) | Nitrogen (dry weight %) | C:N (dry weight) | Moisture Content | Bulk Density |
|---|---|---|---|---|---|---|---|
| Expected Food Waste | 8692 | 17384600 | 28974 | 3.1% | 15 | 70% | 600 lbs/CY |
| Expected Yard Waste | 5625 | 11250000 | 32143 | 2.5% | 20 | 50% | 350 lbs/CY |
| Wood Chips | 5000 | 10000000 | 25000 | 0.1% | 600 | 50.0% | 400 lbs/CY |
| Corrugated Cardboard | 500 | 1000000 | 10000 | 0.1% | 550 | 8.0% | 100 lbs/CY |

| | |
|---|---|
| Carbon Dry Weight (lbs) | 8,743,652 |
| Nitrogen Dry Weight (lbs) | 308,222 |
| C:N | 28.37 |
| Desired Carbon Ratio is | 30:1 |

**See EXCEL worksheet**

| | | |
|---|---|---|
| Moisture Weight (lbs) | 22,874,220 | |
| Total Weight (lbs) | 39,634,600 | |
| Moisture Content | 58% | |
| Desired Moisture Content is | 55% | to 60% |

| | | |
|---|---|---|
| Total Weight (lbs) | 39,634,600 | |
| Total Volume (CY) | 96,117 | |
| Total Density (lbs/CY) | 412 | |
| Desired Bulk Density is | 900 lbs/CY | to 1200 lbs/CY |

# Collection Factors

- Volume, composition, participation rate
- Curbside collection or self-haul
- Separate or co-collection recyclables
  - On-call brush collection
  - Separate collection for fall leaves or holiday trees
  - Type of container – bags, carts
  - Type of collection vehicle – automated, vacuums
- Collection frequencies, schedules, seasonal
- Costs and funding

# *Commercial or Institutional Waste Collection*

- Food prep wastes directly into brute/ barrel or slim jims, lined or unlined
- Sometimes run through pulper or dewatering machine, then into barrel
- Barrels rolled to dock and emptied into dumpster lined with cardboard

# *Commingling Materials*

***– single container for all organics***

- **Advantages**
  - Convenience = high participation
  - One collection truck
  - Carts and automated loading mechanism
  - Lower collection labor
  - Lower overall cost of collection
- **Disadvantages**
  - Commingled “hard” & “soft”, wet wastes must all be ground at processing site
  - Where plastic bags are used for collection, extra labor is required to debag
  - Brush separation may be required:
    - For higher product grades
    - With curbside chipping

# *Separated Materials*

***– brush/wood set out separately from leaves/grass/food waste***

- **Advantages**
  - Increased processing efficiency
  - Reduced site processing costs
  - Faster decomposition of soft-only wastes
  - At the processing site, wood chips can be added as needed to balance C:N
- **Disadvantages**
  - Increases promotion and education costs
  - Requires specialized trucks (e.g., compartmentalized) or 2 trucks or chipper
  - Potentially more collection labor than for a commingled method
  - May require separate collection routes for trucks

# *Loose Material Collection*

***– raked out to curb, no bags or carts***

- **Advantages**
  - Convenient – conducive to participation
  - Amount of material set-out is unrestricted
  - Contaminants are more visible
  - No container costs
  - No bags to remove in processing
- **Disadvantages**
  - Potentially greater contamination than for contained material
  - Requires specialized equipment to move materials from curb to truck
  - Wet material is difficult to handle, and may cause odors; materials may clog street drains
  - Food waste still needs a container and collection

# *Contained Material Collection*

***– in bags or carts***

- **Advantages**
  - Less equipment and potentially less labor than for loose material
  - Potentially less contamination than for loose material
  - Material is not litter-prone or problematic for traffic, parking, sewers
  - Promotes participation
- **Disadvantages**
  - Initial capital costs for containers may be high
  - May require specialized trucks (automated or semi-automated)
  - Amount of material set-out may be limited to container capacity
  - May need separate leaf collection program to handle the large volume of leaves in the fall


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# *Plastic Bags*

- Plastic bags – not recommended and in most communities, banned from use
  - Can develop anaerobic conditions, odor
  - Plastic blows around processing site
  - Plastic fragments remain in finished compost
- Compostable plastic bags
  - Higher cost than paper bags
  - Plastic fragments can remain in finished compost if not completely decomposed
  - Can also develop anaerobic odor if left in bag

# *Paper "Kraft" Bags*

- **Advantages**
  - Less expensive than compostable plastic bags (25¢-39¢ vs. $1)
  - Bag can be shredded by windrow turners – no debagging, less costs
  - Allows airflow during collection process
  - Stand upright, less likely to tear
- **Disadvantages**
  - More expensive than traditional plastic bags (9¢)
  - May lose strength under prolonged wet conditions, making handling difficult
  - Non-degradable items (such as glass bottles, bricks, cans) cannot be seen through the paper

# *Carts and Bins*

- **Advantages**
  - Fewer vehicles and workers required for collection = lower costs
  - 32, 64 or 96-gal carts are durable
  - Easy for generators
  - Small 5-gallon containers can be used for oil and grease
  - 2-cy dumpsters for food waste from institutions
- **Disadvantages**
  - Initial investment is high if municipality or hauler provide carts
  - Automated tipping equipment may be needed for curb carts and possibly bins
  - Smaller bins have limited capacity, especially for fall leaves

# Dock Collection and Upgrades

- **Containers rolled to dock**
  - Cart-swap program
  - Emptied into compactor, compacting truck or dumpster lined with cardboard
  - Can be emptied / transported into on-site in-vessel composter
- **Dock Modifications**
  - Dumpsters
  - Compactors / Electrical
  - Dock / Railings


# *Collection Equipment*

- **General gathering**
  - Front-end loader
  - Mechanical claw truck
- **Material-specific**
  - Leaf vacuum truck or leaf loader
  - Mobile chipping unit for wood waste
- **Transport**
  - Dump truck
  - Rear-loading packer truck (also semi-automated)
  - Automated or semi-automated side-loading truck


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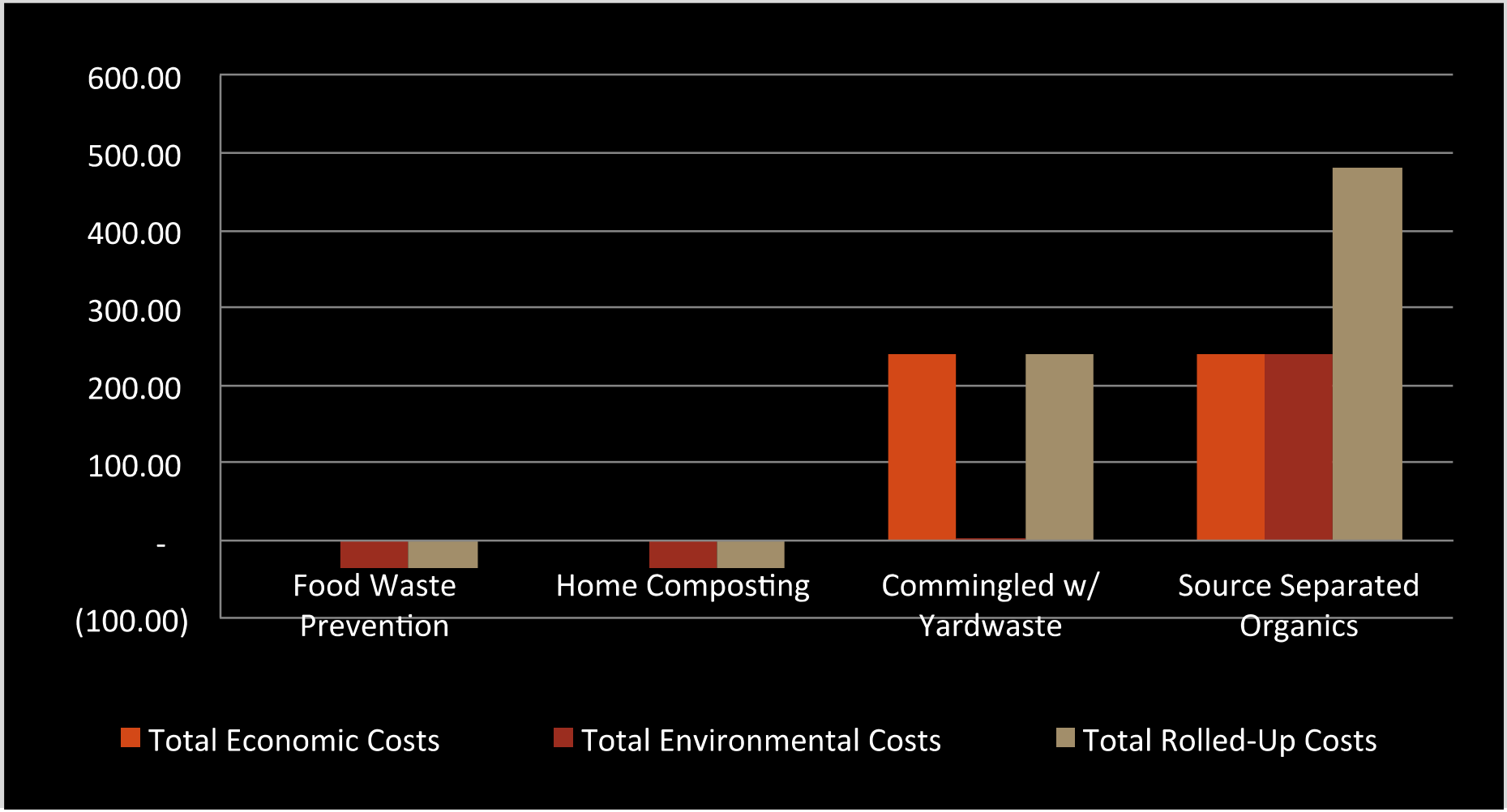
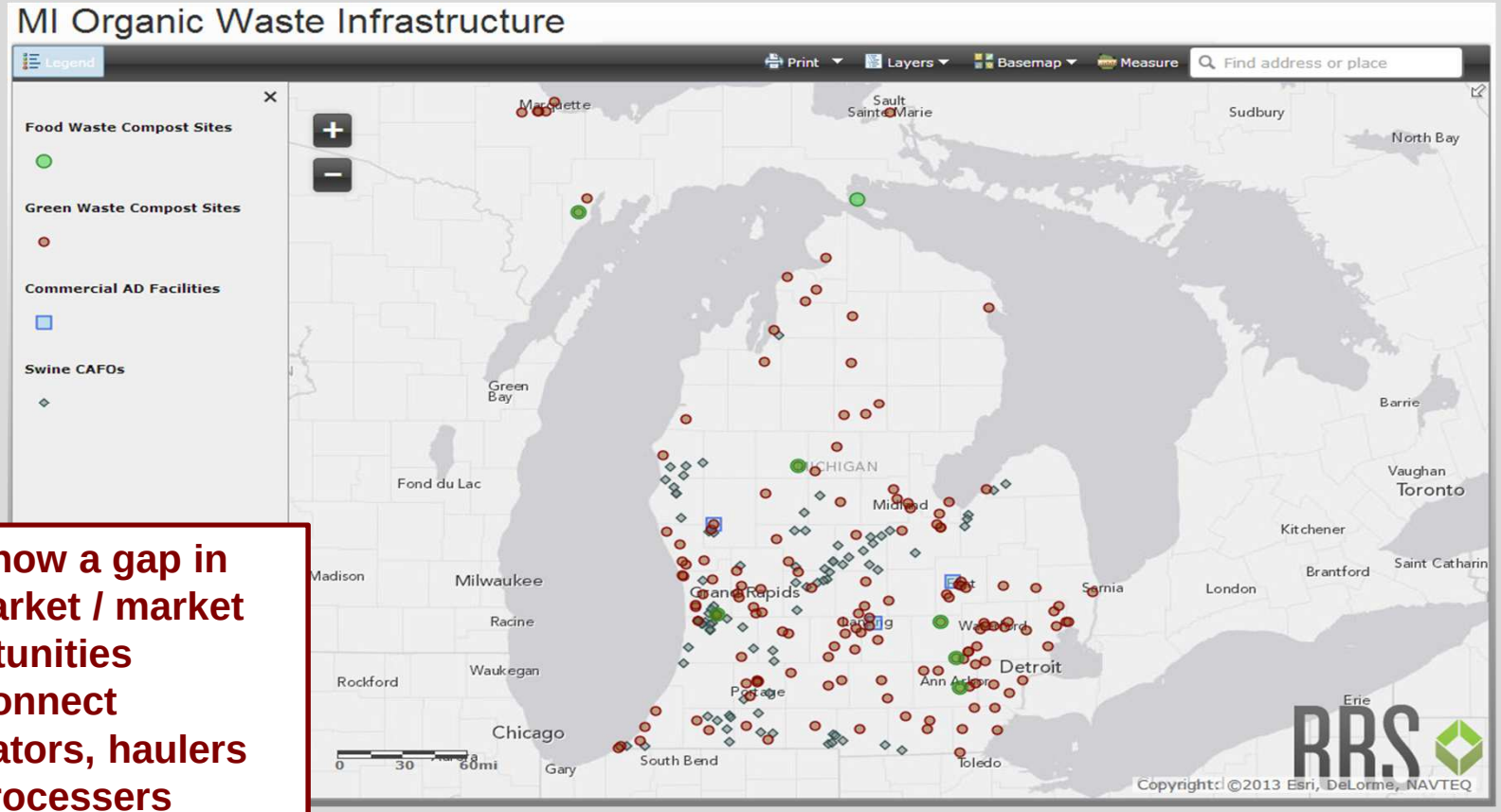
# Characterization and Collection

## Collection Performance



# Using Technology to Create Solutions for Diversion




- Can show a gap in the market / market opportunities
- Can connect generators, haulers and processers

# *Characterization and Collection*

# *Case Study: University of Michigan*

- Program began in 1997
  - 5 Dining Halls, 1 Catering Kitchen, 1 Coffee Shop
- 67 tons of food waste annually
- 32-gal bins picked up 2-3 times/week
- Organics processed at WeCare / City of Ann Arbor Compost Facility - $38/ton compost tip fee
- All organics + bioware from Business School processed at Tuthill Composting
- Significantly more organics available
  - animal bedding
  - yard waste (currently composted at UM grounds)
  - post-consumer foods and products
  - fats, oils, greases
  - soiled paper towel, napkins and cardboard
- Up to 5,269 tons plus yardwaste!

# *Characterization and Collection*

# *Case Study: Metro Health Hospital*

- Program began in 2009
- 300-bed facility
- Six days a week, New Soil picks up two lined 2-cy dumpsters of hospital food waste + OCC (approx. 0.5 tons/day
- Delivers it to Spurt Industries Composting Facilty
- Costs about $50/ton
- Accepts bioware and cardboard


# Case Study: City of Ann Arbor Commercial and Residential

- **Commercial**
  - Semi-automated side loader
  - Vegetative food waste stored in 64 and 32-gal city-provided carts
  - 3x/week collection
- **Residential:**
  - 96, 64 and 32-gallon Compost Carts provided for semi-automated collection of yard waste and food waste
  - Weekly seasonal pickups, Apr – Nov (break in winter months)
  - Residents may wrap produce waste in newspaper to help keep carts clean


# *Characterization and Collection*

**Thank you!**

**Nicole Chardoul, P.E.**

**Resource Recycling Systems**

**nchardoul@recycle.com**

**734-417-4387**